Competence Development Program; Vision on Architecting and Education

by Gerrit Muller    University of South-Eastern Norway-NISE

  e-mail: gaudisite@gmail.com

  www.gaudisite.nl

Abstract

The TNO vision on competence development of architects is described. Architect, Architecture, and Architecting are placed in perspective. A didactic model of the layers attitude, ability, skills, and knowledge is the framework for the vision on education.
TNO-ESI evolved the competence development program for architects over many years.

Joris van den Aker is program manager and driver behind the program.
Our Primary Interest

devloping organization

architect

system of interest
Context, Zoom-out and Zoom-in

- Customer organization
- Developing organization
- Architect
- Supplier organization

- Super system
- System of interest
- Subsystems
Adding the Time Dimension

past  current  future

customer organization

past super system  super system  future super system

developing organization

past system of interest  system of interest  future system of interest

architect

knowledge

innovation

supplier organization

past subsystems  subsystems  future subsystems

based on TRIZ
Architect, Architecture, Architecting

- past
  - past super system
  - past system
  - past subsystems
- current
  - super system
  - subsystems
- future
  - future super system
  - future systems

- customer organization
- developing organization
- architecting
- architect
- supplier organization

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Challenges

past  current  future

customer organization

heterogeneity

size & complexity

ambiguity

unknowns

architect

system of interest

knowledge

innovation

uncertainties

subsystems

based on TRIZ

legacy constraints
From Theory to Practice

Theory: typical SE workflow: V-model, requirements management, “top-down”

- **verification** of result against specification
- **validation**

```
needs
specification
system design
subsystem design
component design
component realization
```

**requirements**

- specification as input to the design, documented
- **SMART**
  - Specific, Measurable, Acceptable, Realistic, Traceable

**requirements engineering**

the flow down of the requirements through the V.

Practice: Finite knowledge and wisdom causes late disruptions

- size & complexity
- heterogeneity
- ambiguity
- unknowns
- uncertainties
- legacy constraints

Innovation and new territory require *learning*, e.g. *experimenting, exploring, failing, discovering*

complement with “bottom-up”
Waterfall model

- identify needs
- specify
- design
- realize
- integrate
- verify & validate

**Works well:**
- in mature product-market combinations
- with long development cycles

**Works poorly:**
- in new product-market combinations
- short development cycles
Concurrent Engineering

- identify needs
- specify
- design
- realize
- integrate
- qualify

- total development time is shorter
- technology constraints & opportunities take time to get in the picture
- validation is still late (=feedback on uncertain requirements)
Iterative Approach

- identify needs
- specify
- design
- realize
- integrate
- qualify

Learn fast by iterating over needs and technology
- more chaotic
- requires agile mindset

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BSEARIterativeApproach
Architect and Typical Expectation from Organization

- **parts**
- **characteristics**
- **dynamics**
- **interact**
- **results in**
- **prime interest of customer**
- **prime system responsibility**
- **prime interest of organization**
- **functionality**

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Final Delivery: T-shape Presentation to Top Management

- societal trends
- opportunities
- problems
- needs
- business/market competition trends
- opportunities
- problems
- needs
- customers stakeholders
- key drivers
- concerns
- applications
- product project system
- functions
- key performance
- design and concepts
- functional, physical
- quantified
- specific aspects
- functional, physical
- quantified
- technology
- critical or new

- business quantification
- risk analysis
- conclusions and recommendations
- summary how solution answers needs
- summary and conclusions why choices are appropriate
- why choices are appropriate
Competence Development: working at multiple levels

- **what**
  - Knowledge
  - Skills
  - Ability
  - Attitude

- **how**
  - Lecturing
  - Exercises
  - Assignments
  - Practice
  - Coaching
  - Reflection

- **who**
  - Participant
  - Teacher/Coach
Architecting: Fit-For-Purpose

- Market and customer context
- Life cycle context

System architecting
- Multi-disciplinary design
  - Software engineering
  - Electrical engineering
  - Mechanical engineering

Mono-disciplinary engineering

- Understand context
- Analyse needs
- Specify system
- Explore design options
- Design, engineer, build, test
- Validate & verify

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BSEARarchitecting
Delivery at the end of this module

- value proposition
- business proposition
- system architecting
- system specification
- design
- software engineering
- electrical engineering
- mechanical engineering
- market and customer context
Alternate Knowledge/Skills and Attitude

- attitude
- ownership development
- take stakeholder’s viewpoint
- be critical and sharp
- embrace uncertainty

- ability
- role architect
- framework
- modeling

- skills
- knowledge

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CDPVpath